

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 06-194242

(43)Date of publication of application : 15.07.1994

(51)Int.Cl. G01L 5/16
A63B 37/00
G01M 9/06

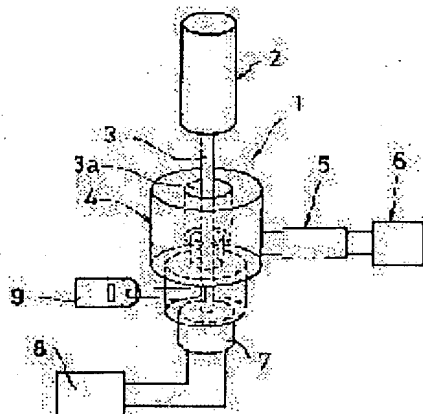
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(54) METHOD AND DEVICE FOR MEASURING DRAG AND LIFT**(57)Abstract:**

PURPOSE: To provide a method and a device for measuring drag and lift by which the drag coefficient and lift coefficient of a golf ball can be easily measured through its simulation.

CONSTITUTION: This measuring device is mainly composed of an aluminum shaft 3 for fitting a columnar object 2 to be measured that is provided on its circumferential face with a recessed part that has the same shape as that of a dimple formed on the surface of a golf ball, a strain-type center axis 3 component force detector 4 connected with the shaft 3 by interposing an acryl resin plate 3a in between, and a signal processor 6 connected with the detector 4 through a DC strain amplifier 5, and further the base end part of the part 3 is connected with a power controller 8 through a driving motor 7, while a digital tachometer 9 is connected with the side face of the shaft 3. The object 2 is artificially created so as to be like an actual golf ball.

**LEGAL STATUS**

[Date of request for examination] 05.11.1999

[Date of sending the examiner's decision of rejection] 03.07.2001

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平6-194242

(43)公開日 平成 6 年(1994) 7 月15日

(51)Int.Cl. ⁵	識別記号	庁内整理番号	F I	技術表示箇所
G 0 1 L 5/16		8505-2F		
A 6 3 B 37/00		7012-2C		
G 0 1 M 9/06		7204-2G		

審査請求 未請求 請求項の数 2 (全 4 頁)

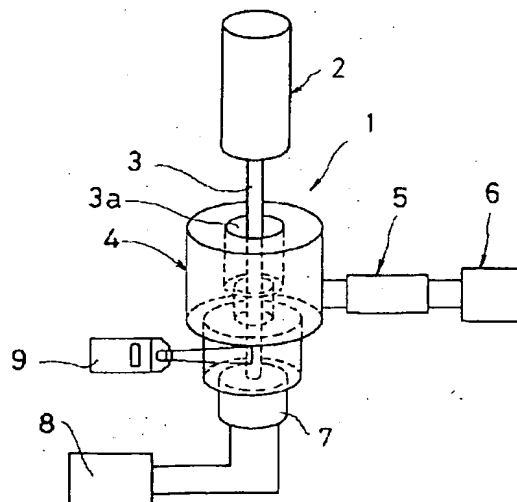
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(54)【発明の名称】 抗力・揚力測定方法及びその装置

(57)【要約】 (修正有)

【目的】 ゴルフボールの抗力係数と揚力係数とをシュミレーションにより簡便に測定することが出来る抗力・揚力測定方法及びその装置を提供する。

【構成】 抗力・揚力測定装置 1 は、主としてゴルフボールの表面に形成するディンプルの形状と同様な形状の溝部を外周面に形成した円柱状の被測定体 2 を取付けるアルミシャフト 3 と、このアルミシャフト 3 を、アクリル樹脂板 3 a を介して連結した歪型中軸 3 分力検出器 4 と、この歪型中軸 3 分力検出器 4 に、直流型歪増幅器 5 を介して接続されたシグナルプロセッサ 6 とで構成され、アルミシャフト 3 の基端部は、駆動モータ 7 を介してパワーコントローラ 8 に接続され、またアルミシャフト 3 の側面には、デジタルタコメータ 9 が接続されている。円柱状の被測定体 2 は、実際のゴルフボールを疑似的に創作したものである。



【特許請求の範囲】

【請求項1】 抗力・揚力測定装置のシャフトの先端にゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた被測定体を取付け、この被測定体を風洞装置の測定部に配設し、前記被測定体を測定部内で所定の回転数で回転させながら、かつ風洞装置の一侧部から所定流速の整流を測定部に送り込み、この時にシャフトに生じる歪を抗力・揚力測定装置の歪型中軸3分力検出器の受感部へ伝達して電気信号に変換し、この変換された電気信号をシグナルプロセッサで信号処理した後、コンピュータで計測機からの出力を計算して被測定体の抗力係数及び揚力係数を求めることを特徴とする抗力・揚力測定方法。

【請求項2】 ゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた被測定体をシャフトを介して取付ける抗力・揚力測定装置と、前記被測定体を設置する風洞装置とから成り、前記抗力・揚力測定装置は、回転駆動制御装置を介して回転自在なシャフトを連結支持する歪型中軸3分力検出器と、この歪型中軸3分力検出器に、直流型歪増幅器を介して接続されたシグナルプロセッサと、このシグナルプロセッサにより信号処理された値を計算して、抗力係数及び揚力係数を求める制御装置とで構成したことを特徴とする抗力・揚力測定装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、円柱及び球体の抗力・揚力測定方法及びその装置に係わり、更に詳しくは円柱体の外周面及び球体の表面に所定形状のディンプルを形成した疑似ゴルフボール（被測定体）によって、あたかもゴルフボールで測定する場合と同様に空力特性、特に抗力係数と揚力係数とを測定することを可能とした抗力・揚力測定方法及びその装置に関するものである。

【0002】

【従来の技術】従来、ゴルフボールの空力特性、特に抗力係数と揚力係数とを測定する場合、ゴルフボールが製品化された後、そのゴルフボールを使用して抗力係数と揚力係数を風洞装置等を使用して測定していた。ゴルフボールの空力特性、特に抗力係数と揚力係数は、ゴルフボールの飛距離に重大な影響を与える要因となっており、この抗力係数と揚力係数との比率、即ち、揚抗比が大きいか、小さいかを判断することによってゴルフボールの飛距離を判断出来るものである。

【0003】

【発明が解決しようとする問題点】然しながら、従来では新しいゴルフボールを設計する場合、ゴルフボールがある程度製品化されるまでは、抗力係数及び揚力係数を測定する装置や、測定する方法がなく、従って、目的とするゴルフボールを設計するまでには、多大な費用と労力及び長期間を必要としていた。

【0004】この発明は、かかる従来の課題に着目して案出されたもので、ゴルフボールの表面に形成するディンプルの形状を、円柱体または球体等の被測定体の表面に形成して、この被測定体を疑似ゴルフボールとすることで、目的とするゴルフボールの抗力係数と揚力係数とをシュミレーションにより簡便に測定することが出来る抗力・揚力測定方法及びその装置を提供することを目的とするものである。

【0005】

【課題を解決するための手段】この発明は上記目的を達成するため、ゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた被測定体をシャフトを介して取付ける抗力・揚力測定装置と、前記被測定体を設置する風洞装置とから成り、前記抗力・揚力測定装置は、回転駆動制御装置を介して回転自在なシャフトを連結支持する歪型中軸3分力検出器と、この歪型中軸3分力検出器に、直流型歪増幅器を介して接続されたシグナルプロセッサと、このシグナルプロセッサにより信号処理された値を計算して、抗力係数及び揚力係数を求める制御装置とで構成したことを要旨とするものである。

【0006】

【発明の作用】この発明は上記のように構成され、抗力・揚力測定装置のシャフトの先端にゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた被測定体を取付け、この被測定体を風洞装置の測定部に配設し、前記被測定体を測定部内で所定の回転数で回転させながら、かつ風洞装置の一侧部から所定流速の整流を測定部に送り込み、この時にシャフトに生じる歪を抗力・揚力測定装置の歪型中軸3分力検出器の受感部へ伝達して電気信号に変換し、この変換された電気信号をシグナルプロセッサで信号処理した後、コンピュータで計測機からの出力を計算して被測定体の抗力係数及び揚力係数を求めることにより、目的とするディンプルを備えた被測定体で抗力係数と揚力係数とを簡便に測定するが出来るものである。

【0007】

【発明の実施例】以下、添付図面にに基づき、この発明の実施例を説明する。図1は、この発明を実施した抗力・揚力測定装置1の概略構成図を示し、この抗力・揚力測定装置1は、主としてゴルフボールの表面に形成するディンプルの形状と同様な形状の溝部を外周面に形成した円柱状の被測定体2を取付けるアルミシャフト3と、このアルミシャフト3を、アクリル樹脂板3aを介して連結した歪型中軸3分力検出器4と、この歪型中軸3分力検出器4に、直流型歪増幅器5を介して接続されたシグナルプロセッサ6とで構成されている。

【0008】前記アルミシャフト3の基端部は、駆動モータ7を介してパワーコントローラ8に接続され、またアルミシャフト3の側面には、デジタルタコメータ9が

接続されている。前記円柱状の被測定体2は、図2に示すように例えば、ラージゴルフボールの径(42.67mm)と略同じ径で、長さ100 mmの円柱状に形成され、この被測定体2の外周面には周方向に所定の間隔でディンプルの断面形状と同一の形状で、かつ長手方向に長溝10を形成し、実際のゴルフボールを疑似的に創作したものである。

【0009】上記のような円柱状の被測定体2をアルミシャフト3に取付けて、被測定体2の抗力係数と揚力係数とを測定する場合には、図3に示すような風洞装置11を用いて行うものである。この風洞装置11は、空気力学的測定及び流れの可視化を行う目的で製作された吸い込み型風洞で、平均流速0~60 m/secまで測定可能である。この風洞装置11は、主として、整流部12と、縮流長さ比が0.9、縮流面積比が9:1の縮流部13と、断面正方形の測定部14及び人間が出入り出来る測定用ボックス15とで構成され、整流部12は整流金網16aと整流格子16bとから構成され、また測定部14は透明アクリル樹脂製板で製作され、外部から測定状態を可視化出来るように構成され、また測定部14の下側は、被測定体2の設置を容易にするために図示しない開閉扉が設けられている。

【0010】次に、被測定体2の抗力・揚力の測定方法を説明すると、まず抗力、揚力測定装置1による測定は、前記被測定体2をアルミシャフト3の先端に固定し、この被測定体2とアルミシャフト3とを、風洞装置11の測定部14に設置する。このような状態で、前記被測定体2を測定部14内で駆動モータ7を介してパワーコントローラ8を介して所定の回転数で回転させ、また同時に風洞装置11の側部に設けた送風装置(図示せず)から所定流速の風を送り込み、この風を整流部12で整流させて被測定体2を設置した測定部14に送り込み、一方整流は、風洞装置11の他側部に設けた吸引装置で吸引させている。

【0011】このような状態で被測定体2を一定の速度で回転させた時に、アルミシャフト3に歪が生じ、この歪が歪型中軸3分力検出器4の受感部へ伝達され、電気信号に変換される。そして、この変換された電気信号は、直流型歪増幅器5を介してシグナルプロセッサ6で信号処理され、この処理された信号をコンピュータで計測機からの出力を計算して抗力係数及び揚力係数を求めるものである。

【0012】実際には、まず測定する前に、アルミシャフト3についてレイノルズ数と回転数とを変化させて、各分力を測定する。この時、流速は20~53 m/sec、回転数は100,000rpmまでである。円柱状の被測定体2もアルミシャフト3と同様な方法で、レイノルズ数と回転数及び円柱表面の形状を変化させた時の各分力を測定し、模擬ゴルフボールとしての被測定体2の測定値からアルミシャフト3の測定値を引いた値を、シグナルプロ

セッサ6によって平均化演算を行い、乱れ成分を除去し、その後は、上記のような方法によって測定を行うものである。

【0013】なお、この実施例では、模擬ゴルフボールとして、円柱状の被測定体2を使用した。製品化されたゴルフボールについての抗力係数及び揚力係数を求めることが出来るのは勿論である。この発明は、上記のように抗力・揚力測定装置1のアルミシャフト3の先端にゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた疑似的な被測定体2を取付け、この被測定体2を風洞装置11の測定部14に配設して抗力・揚力測定装置1によって被測定体2の抗力係数及び揚力係数を求めるので、従来のように、実際のゴルフボールが製品化されなくても、ゴルフボールと同じ略状態で抗力・揚力の測定が可能となり、これにより目的とするディンプルを備えたゴルフボールと同様な抗力係数と揚力係数とを簡便に測定するが出来るものである。

【0014】

【発明の効果】この発明は、上記のようにゴルフボールの表面に形成するディンプルの形状と同様な形状の凹部または溝部を備えた被測定体をシャフトを介して取付ける抗力・揚力測定装置と、前記被測定体を設置する風洞装置とから成り、前記抗力・揚力測定装置は、回転駆動制御装置を介して回転自在なシャフトを連結支持する歪型中軸3分力検出器と、この歪型中軸3分力検出器に、直流型歪増幅器を介して接続されたシグナルプロセッサと、このシグナルプロセッサにより信号処理され値を計算して、抗力係数及び揚力係数を求める制御装置とで構成したので、従来のように、実際のゴルフボールが製品化されなくても、ゴルフボールと略同じ状態での抗力・揚力の測定が可能となり、安価で、かつ目的とするディンプルを備えたゴルフボールと同様な抗力係数と揚力係数とを簡便に短時間に測定するが出来る効果がある。

【図面の簡単な説明】

【図1】この発明を実施した抗力・揚力測定装置の概略構成図である。

【図2】ゴルフボールに対して疑似的に製作した被測定体の一部斜視図である。

【図3】抗力・揚力測定方法に用いる風洞装置の概略正面図である。

【符号の説明】

1 抗力・揚力測定装置	2 被測定体
3 シャフト(アルミシャフト)	4 歪型中軸3分力検出器
5 直流型歪増幅器	6 シグナルプロセッサ
7 駆動モータ	8 パワーコントローラ
9 デジタルタコメータ	10 長溝

(4)

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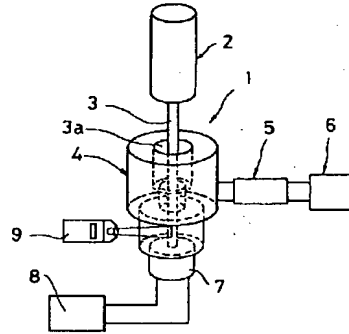
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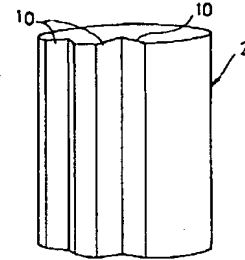
11 風洞装置

12 整流部 * * 14 測定部

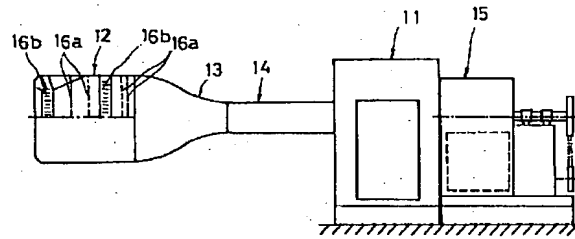
【図1】



【図2】



【図3】



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CLAIMS

[Claim(s)]

[Claim 1] The measured field equipped with the concavity of the configuration of the dimple formed at the nose of cam of the shaft of reaction and a lift measuring device on the surface of a golf ball and the same configuration or Mizobe is attached. arranging this measured field in the test section of wind tunnel equipment, and rotating the aforementioned measured field at a predetermined rotational frequency within a test section And send a rectification of the predetermined rate of flow into a test section from one flank of wind tunnel equipment, transmit distortion produced at a shaft at this time to ***** of the distortion type axis 3 component-of-a-force detector of reaction and a lift measuring device, and it changes into an electrical signal. The reaction and the lift measuring method characterized by calculating the output from a measuring machine by computer, and asking for the drag coefficient and lift coefficient of the measured field after carrying out signal

processing of this changed electrical signal by the signal processor.

[Claim 2] The reaction and the lift measuring device which attaches the measured field equipped with the concavity of the configuration of the dimple formed on the surface of a golf ball, and the same configuration, or Mizobe through a shaft, It consists of the wind tunnel equipment which installs the aforementioned measured field. aforementioned reaction and lift measuring device The distortion type axis 3 component-of-a-force detector which carries out link support of the shaft which can be rotated freely through a rotation drive control unit, The reaction and the lift measuring device characterized by constituting from a signal processor connected to this distortion type axis 3 component-of-a-force detector through flowed-in one direction type oval amplifier, and a control unit which calculates the value in which signal processing was carried out by this signal processor, and asks for a drag coefficient and a lift coefficient.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the reaction and the lift measuring method which enabled it to measure an aerodynamic characteristics especially a drag coefficient, and a lift coefficient like the case where it measures with a golf ball, and its equipment still in detail with respect to a circular cylinder, spherical reaction, a lift measuring method, and its equipment with the false golf ball (measured field) in which the dimple of a predetermined configuration was formed the periphery side of the circular cylinder field, and on the surface of the sphere.

[0002]

[Description of the Prior Art] When the aerodynamic characteristics of a golf ball especially a drag coefficient, and a lift coefficient were measured conventionally, after producing a golf ball commercially, the drag coefficient and the lift coefficient were measured using wind tunnel equipment etc. using the golf ball. The aerodynamic characteristics especially the drag coefficient, and lift coefficient of a golf ball are the factor which has serious influence for the flight distance of a golf ball, and the flight distance of a golf ball can be judged whether the proportion of this drag coefficient and lift coefficient, i.e., a L/D ratio, is large, and by judging whether it is the parvus.

[0003]

[Problem(s) to be Solved by the Invention] However, in the former, by the time there is neither equipment which measures a drag coefficient and a lift coefficient, nor the technique of measuring, therefore it designed the target golf ball until the golf ball was produced to some extent commercially when designing a new golf ball, the great cost, the effort, and the long period of time were needed.

[0004] This invention was thought out paying attention to such a conventional technical problem, forms the configuration of the dimple formed on the surface of a golf ball in the front face of the measured fields, such as the circular cylinder field or a sphere, is using this measured field as a false golf ball, and aims at offering the reaction and the lift measuring method which can measure the drag coefficient and lift coefficient of the golf ball made into the purpose simple by the simulation, and its equipment.

[0005]

[Means for Solving the Problem] The reaction and the lift measuring device which attaches the measured field equipped with the concavity of the configuration of the dimple formed on the surface of a golf ball, and the same configuration, or Mizobe in order that this invention might attain the above-

mentioned purpose through a shaft, It consists of the wind tunnel equipment which installs the aforementioned measured field. aforementioned reaction and lift measuring device The distortion type axis 3 component-of-a-force detector which carries out link support of the shaft which can be rotated freely through a rotation drive control unit, Let it be a summary to have constituted from a signal processor connected to this distortion type axis 3 component-of-a-force detector through flowed-in one direction type oval amplifier, and a control unit which calculates the value in which signal processing was carried out by this signal processor, and asks for a drag coefficient and a lift coefficient.

[0006]

[Function of the Invention] This invention is constituted as mentioned above and the measured field equipped with the concavity of the configuration of the dimple formed at the nose of cam of the shaft of reaction and a lift measuring device on the surface of a golf ball and the same configuration or Mizobe is attached. arranging this measured field in the test section of wind tunnel equipment, and rotating the aforementioned measured field at a predetermined rotational frequency within a test section And send a rectification of the predetermined rate of flow into a test section from one flank of wind tunnel equipment, transmit distortion produced at a shaft at this time to ***** of the distortion type axis 3 component-of-a-force detector of reaction and a lift measuring device, and it changes into an electrical signal. By calculating the output from a measuring machine by computer, and asking for the drag coefficient and lift coefficient of the measured field, after carrying out signal processing of this changed electrical signal by the signal processor It can do, although a drag coefficient and a lift coefficient are measured simple with the measured field equipped with the target dimple.

[0007]

[Example] Hereafter, the example of this invention is explained based on an accompanying drawing. Drawing 1 shows the outline block diagram of the reaction and the lift measuring device 1 which carried out this invention. this reaction and lift measuring device 1 The aluminum shaft 3 which attaches the measured field 2 of the shape of a circular cylinder of having formed Mizobe of the configuration of the dimple mainly formed on the surface of a golf ball, and the same configuration to the periphery side, It consists of a distortion type axis 3 component-of-a-force detector 4 which connected this aluminum shaft 3 through acrylic resin plate 3a, and a signal processor 6 connected to this distortion type axis 3 component-of-a-force detector 4 through the flowed-in one direction type oval amplifier 5.

[0008] The base edge of the aforementioned aluminum shaft 3 is connected to the power controller 8 through a drive motor 7, and the digital tachometer 9 is connected to the side face of the aluminum shaft 3. the measured field 2 of the shape of an aforementioned circular cylinder is shown in drawing 2 -- as -- for example; the path (42.67mm) of a ***** golf ball and abbreviation -- it is the same path and is formed in the shape of [of length 100 mm] a circular cylinder, and it is the cross-section configuration of a dimple, and the same configuration at the predetermined spacing, and the long slot 10 is formed [a hoop direction] in the periphery side of this measured field 2 at a longitudinal direction, and an actual golf ball is

[0009] In attaching the measured field 2 of the shape of an above circular cylinder in the aluminum shaft 3 and measuring the drag coefficient and lift coefficient of the measured field 2, it carries out using the wind tunnel equipment 11 which is shown in drawing 3 . This wind tunnel equipment 11 is the suction type wind tunnel manufactured in order to perform aerodynamic measurement and a flow visualization, and is measurable to the mean velocities 0-60m / sec. 0.9 and contracted-vein surface ratio this wind tunnel

equipment 11 with the rectification section 12 mainly 9:1 vena contractas 13, [a contracted-vein length ratio] It consists of a box for measurement 15 which cross-section square-like the test section 14 and human being can frequent. The rectification section 12 consists of rectification wire gauze 16a and honeycomb 16b, and a test section 14 is manufactured with the plate made from transparent acrylic resin. The opening-and-closing door which is not illustrated in order that it may be constituted so that the measurement status can be visualized from the exterior, and the test-section 14 bottom may make an installation of the measured field 2 easy is prepared.

[0010] Next, if the measuring method of the reaction and lift of the measured field 2 is explained, first, measurement by reaction and the lift measuring device 1 will fix the aforementioned measured field 2 at the nose of cam of the aluminum shaft 3, and will install this measured field 2 and the aluminum shaft 3 in the test section 14 of the wind tunnel equipment 11. In such the status, mind the aforementioned measured field 2, mind a drive motor 7 within a test section 14, and it is made to rotate at a predetermined rotational frequency through the power controller 8. Moreover, the wind of the predetermined rate of flow is sent in from the ventilation equipment (not shown) simultaneously formed in one flank of the wind tunnel equipment 11, it sends into the test section 14 which was made to rectify this wind in the rectification section 12, and installed the measured field 2, and, on the other hand, the rectification is made to attract by the aspirator prepared in the other flanks of the wind tunnel equipment 11.

[0011] When rotating the measured field 2 at a fixed speed in such the status, distortion arises at the aluminum shaft 3, and this distortion is transmitted to ***** of the distortion type axis 3 component-of-a-force detector 4, and is changed into an electrical signal. And signal processing of this changed electrical signal is carried out by the signal processor 6 through the flowed-in

one direction type oval amplifier 5, it calculates the output from a measuring machine for this processed signal by computer, and asks for a drag coefficient and a lift coefficient.

[0012] In fact, before measuring first, the Reynolds number and a rotational frequency are changed about the aluminum shaft 3, and each component of a force is measured. At this time, the rate of flow has 20-53m / sec, and a rotational frequency to 100,000rpm. It is the same technique as the aluminum shaft 3, and each component of a force when changing the configuration on the Reynolds number, a rotational frequency, and the front face of a circular cylinder is measured, the signal processor 6 performs an equalization operation for the value which lengthened the measured value of the aluminum shaft 3 from the measured value of the measured field 2 as a simulation golf ball, a turbulence component is removed, and the circular cylinder-like measured field 2 also measures by the above technique after that.

[0013] In addition, although the circular cylinder-like measured field 2 was used as a simulation golf ball in this example, of course, it can ask for the drag coefficient about a golf ball and lift coefficient which were produced commercially. This invention attaches the false measured field 2 equipped with the concavity of the configuration of the dimple formed at the nose of cam of the aluminum shaft 3 of reaction and the lift measuring device 1 on the surface of a golf ball as mentioned above, and the same configuration, or Mizobe. Since this measured field 2 is arranged in the test section 14 of the wind tunnel equipment 11 and it asks for the drag coefficient and lift coefficient of the measured field 2 by reaction and the lift measuring device 1 Like before, even if an actual golf ball is not produced commercially, measurement of reaction and lift is attained in the state of the same abbreviation as a golf ball, and although the same drag coefficient and same lift coefficient as the golf ball equipped with the target dimple by this are

measured simple, it can do.

[0014]

[Effect of the Invention] The reaction and the lift measuring device which attaches the measured field equipped with the concavity of the configuration of the dimple which forms this invention on the surface of a golf ball as mentioned above, and the same configuration, or Mizobe through a shaft, It consists of the wind tunnel equipment which installs the aforementioned measured field. aforementioned reaction and lift measuring device The distortion type axis 3 component-of-a-force detector which carries out link support of the shaft which can be rotated freely through a rotation drive control unit, Since it constituted from a signal processor connected to this distortion type axis 3 component-of-a-force detector through flowed-in one direction type oval amplifier, and a control unit which signal processing is carried out by this signal processor, calculates a value, and asks for a drag coefficient and a lift coefficient even if an actual golf ball is not produced commercially like before -- a golf ball and abbreviation -- with measurement of the reaction and lift in the same status being possible, it becomes and there is an effect made although the drag coefficient and lift coefficient cheap and same as the golf ball equipped with the target dimple are measured simple for a short time

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline block diagram of the reaction and the lift measuring device which carried out this invention.

[Drawing 2] a part of measured field manufactured in false to the golf ball -- it is a perspective diagram

[Drawing 3] It is the outline front view of the wind tunnel equipment used for reaction and a lift measuring method.

[Description of Notations]

1 Reaction and Lift Measuring Device 2 Measured Field

3 Shaft (Aluminum Shaft) 4 Distortion Type. Axis 3 Component-of-a-Force
Detector

5 Flowed-in One Direction Type Oval Amplifier 6 Signal Processor

7 Drive Motor 8 Power Controller

9 Digital Tachometer 10 Long Slot

11 Wind Tunnel Equipment 12 Rectification Section

14 Test Section

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